Status of ASKAP Control System

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www.csiro.au

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ASKAP Project
Australian SKA Pathfinder = 1% SKA

- Wide field of view radio telescope
  - Sited at Boolardy, Western Australia
  - Observes between 0.7 and 1.8 GHz
  - 36 antennas, 12m diameter, 3-axis
  - Phased Array Feed (PAF) technology (36 beams)
  - 30 sq degree field of view
  - 6 antenna prototype mid 2011- Boorlardy Engineering Test Array (BETA)
  - Full system mid 2013
- Scientific instrument, optimised for survey
  - Survey HI emission from 1.7 million galaxies up z ~ 0.3
  - Deep continuum survey of entire sky
  - Polarimetry over entire sky
- Technical pathfinder
  - Demonstration of WA as SKA site
  - Phased Array Feeds
  - Computing

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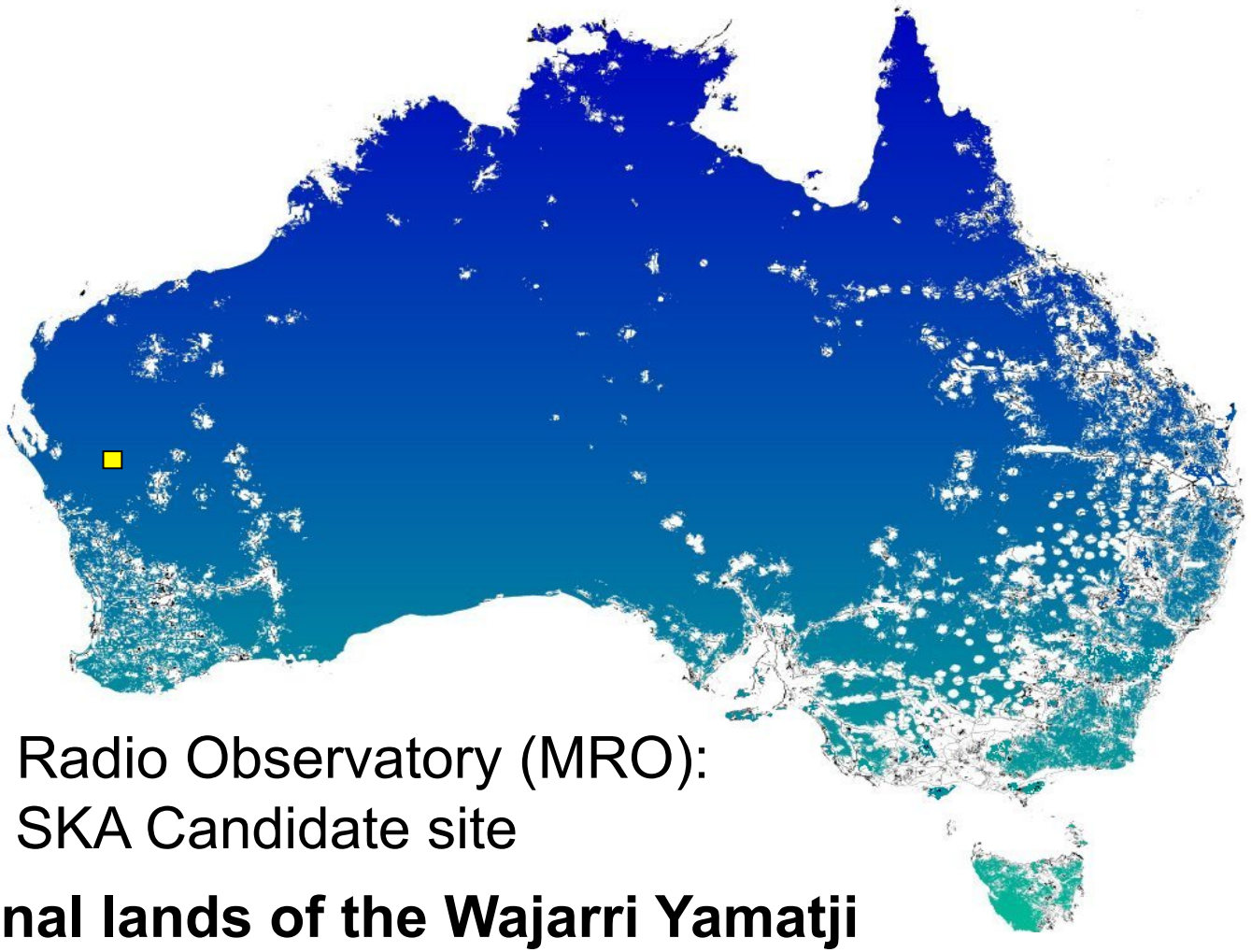
ASKAP Site



Murchison Radio Observatory (MRO):
Australia's SKA Candidate site

Traditional lands of the Wajarri Yamatji

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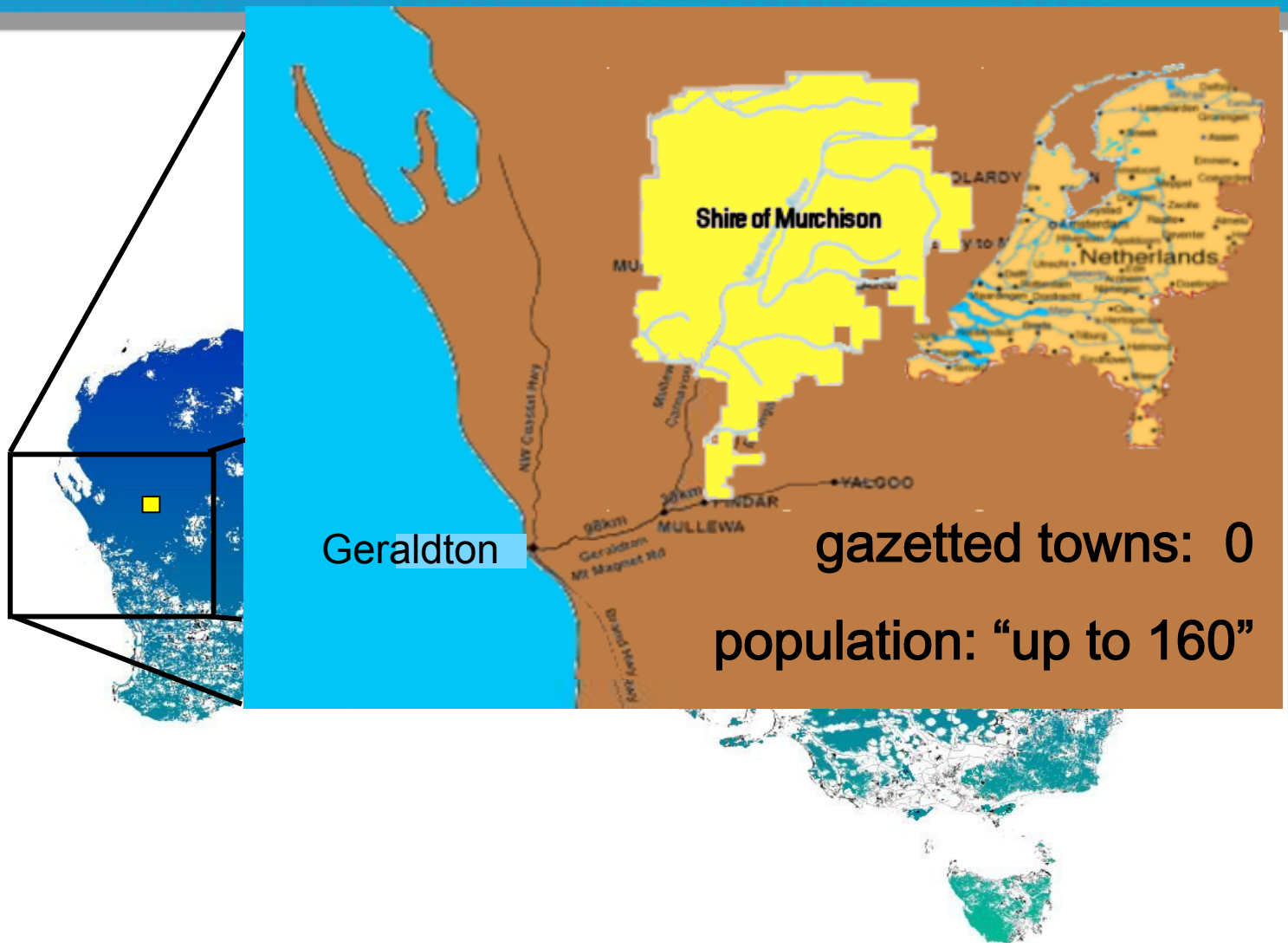

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ASKAP Project Timeline

Jan 2010	First antenna installed at the site
May 2010	Subsystem's CDR completed
Mar 2011	Installation of Full-PAF + new hw/sw backend at Parkes
Mar 2011	SAT of antenna 2 – 6 (BETA) completed
May 2011	Fibre-link between Geraldton and MRO complete
Jun 2011	Installation of Full-PAF+hw/sw back-end on BETA begins
Aug 2011	Early commissioning of BETA begins
Oct 2011	MRO infrastructure complete
Jan 2012	Installation/SAT of antennas 7 – 36 complete
Nov 2012	36 ASKAP antennas with PAF + hw/sw installed
Dec 2012	ASKAP "Early Science" (commissioning/shared risk)
Jul 2013	Initial Science Survey Projects observing

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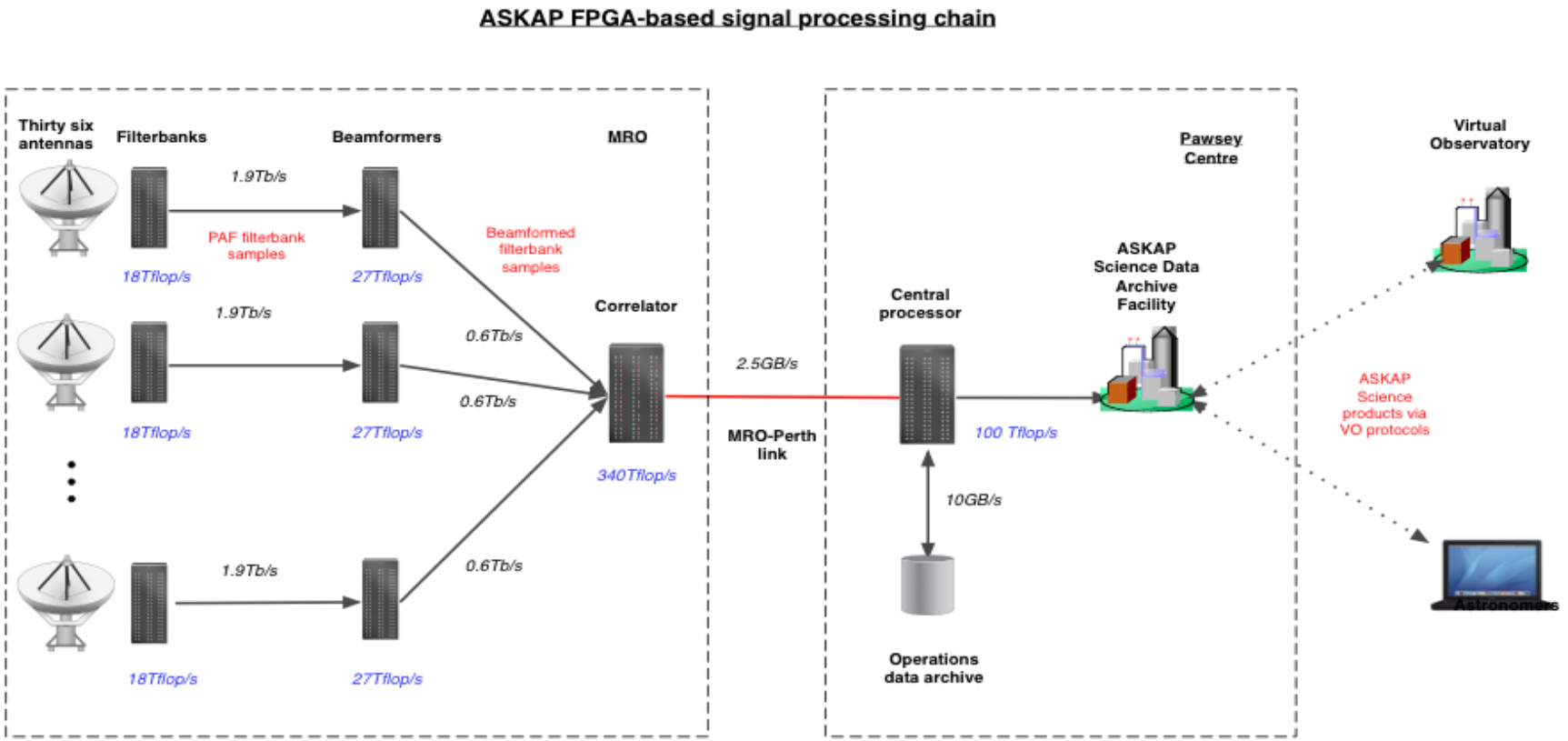
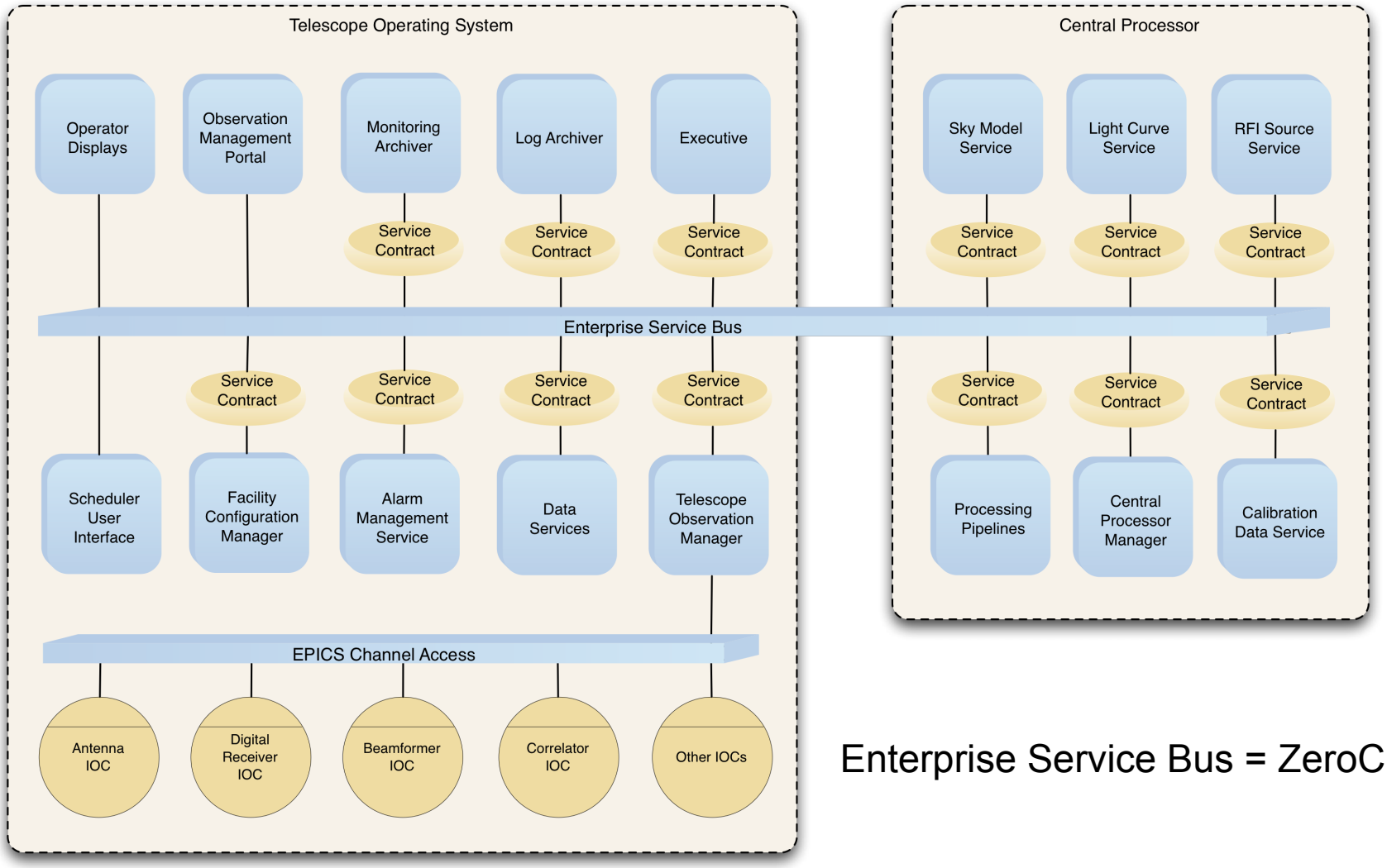
ASKAP Data Flow



T. Cornwell, Feb 22 2010

ASKAP Control Software Architecture



Enterprise Service Bus = ZeroC ICE

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EPICS IOC Implementation

- Using EPICS base 3.14.11
  - Support (development) for Linux (x86_64) and MacOSX (Snow Leopard)
  - No need for real-time OS extensions for now
- Estimated number of records ~ 180,000 (~ 5,000/antenna)
- Estimated number of deployed IOCs ~ 40
  - SoftIOC on Linux (non-real time) OS
  - We call them Control Computers
  - 1U rack-type computers running standard Linux (debian) distro x86_64 type (diskless or solid-state disk)

EPICS IOC Implementation

- Design and write the EPICS database (list of EPICS records). Use of ICD as reference
  - Keep IOC database as simple as possible
  - Extensive use of MSI
- Write SNL programs for some applications (version 2.0.12)
- Extensive use of EPICS ASYN framework (version 4.14)
  - Code needs to be added if field-bus protocol requires additional ASYN interfaces, i.e. driver support for the ASKAP Digitiser (UDP-based protocol)
  - Driver support can be re-used. We are planning to use same ASKAP digitiser driver support for LO, Beamformer and Correlator
- Implement an emulator (Python)
  - Essential for continuous integration and testing of high-level software components
  - Most of our hardware devices are Ethernet-enabled
- Implementation of EPICS IOC applications are done mainly by Computing Team (Control Group), but in some cases are shared development, i.e. Analog Subsystem

EPICS Implementation Status

Subsystem	Implementation Status	Fieldbus/Protocol
Antenna Drives	50 %	Ethernet/TCP (ASKAP) and Modbus/ TCP (Parkes 12m)
Pedestal and Prime Focus Analog Electronics	50 %	Ethernet/UDP(SPI)
LO	50 %	Ethernet/UDP
Timing	Completed	Ethernet/UDP/PCI
Digitiser	Completed	Ethernet/UDP
Beamformer	0% ICD in progress	Ethernet/UDP
Correlator	0 %	Ethernet/UDP
Power and Cooling	0 %	Ethernet/TCP(Modbus)/SNMP
MRO Weather Station	0 %	Ethernet/TCP
MRO Safety (Fire alarms, interlocks)	0 %	Ethernet/ModbusTCP
MRO Networking Hardware	0 %	Ethernet/SNMP

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EPICS Clients Implementation

- Using our own Archiver
  - ASKAP will use software called MoniCA which is used for the Monitoring Archiver role at all other CASS/ATNF Observatories
  - Implemented in Java
  - Supports MySQL and ASCII database backends
  - EPICS CA support via JCA library
  - Google “open-monica” or http://code.google.com/p/open-monica/
- GUIs
  - Started using EDM but there are some issues on x86_64 and MacOSX
  - Converting screens to Qt 4.6 + epicsqt library (Australian Synchrotron)
- Test scripts
  - Implemented in Python
  - EPICS CA support via cothread 1.15 (Diamond)
- VirtualTOS (vtos)
  - Stand-alone package with SoftIOC emulating antenna IOCs + High level applications for creating/executing observations

Build Infrastructure
Features

- Revision control system: Subversion
- Support for C/C++, Java and Python for our code
- Platform independent
  - Compiles in Linux (Debian) and MacOSX
  - Deploy only Linux
- Automated building (and deployment) of dependencies
  - A single build command (rbuild)
    - Updates from subversion repository
    - Recursively builds a package's dependencies
    - Written in Python
  - The dependencies.default file lists a packages dependencies
    - To avoid dependency loops have a simple dependency structure
  - Wraps several “make” tools: autotools, epics makefiles, scons, ant and setuptools
    - Integrate lots of 3rd party software as part of our build
    - Standard patching procedure and option settings
    - Support parallel builds – to speed up a little bit
  - Wraps documentation generation tools: doxygen and Sphinx
  - Can build and run unit and functional test

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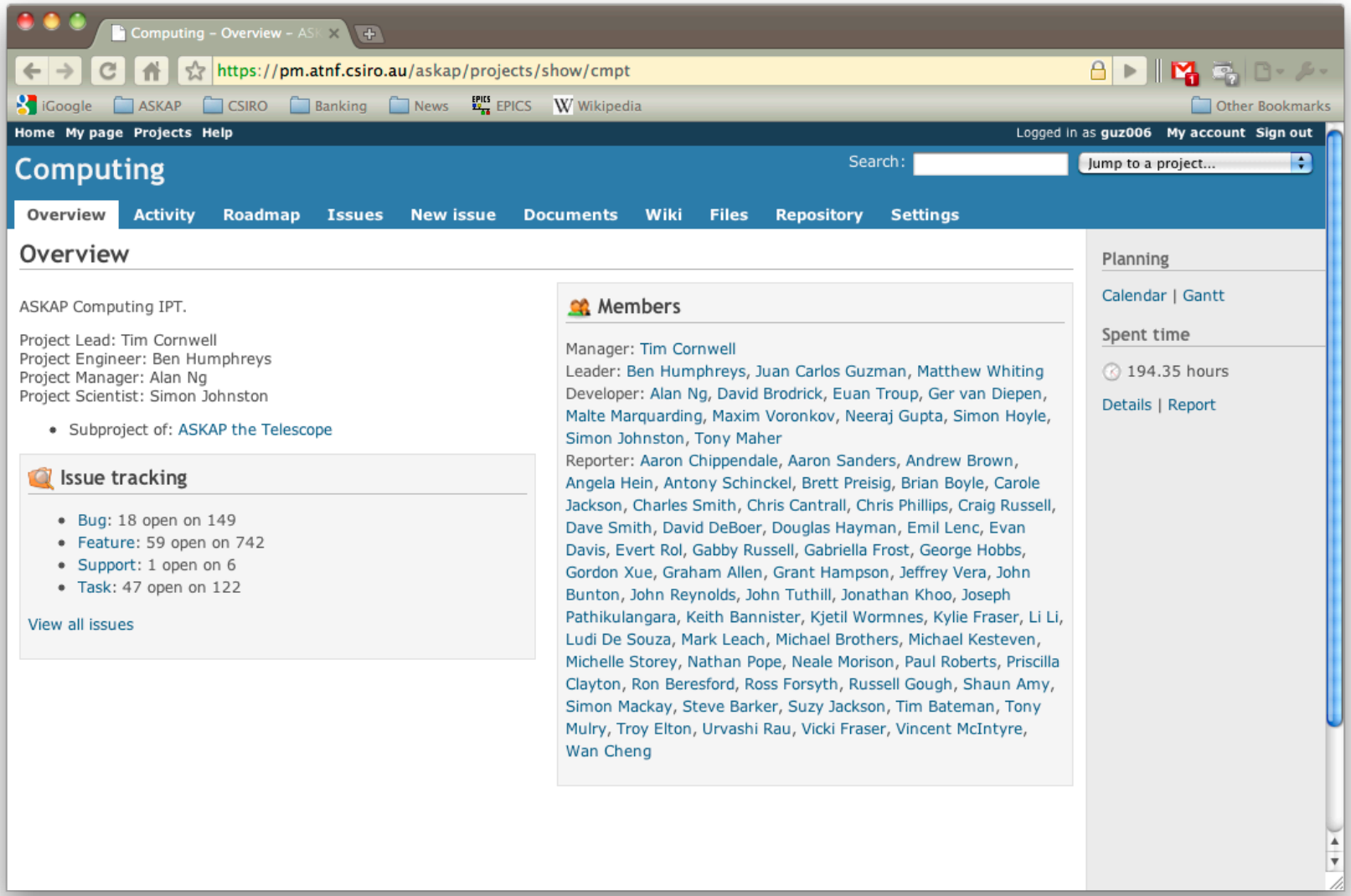
Project Management Tool
Redmine

- Switched from Trac to Redmine late 2009
  - Redmine: http://www.redmine.org
  - Open source project management web application written in Ruby on Rails
  - Allows sub-projects, so it is used by ASKAP
  - Use the concept of issues (task, bug, feature, etc.) and milestones
  - Wiki
  - Linked to source repository (SVN, CVS, Git, Mercurial, etc.)
  - Email notifications
  - Time tracking (although we don't use this)

Project Management Tool
Redmine



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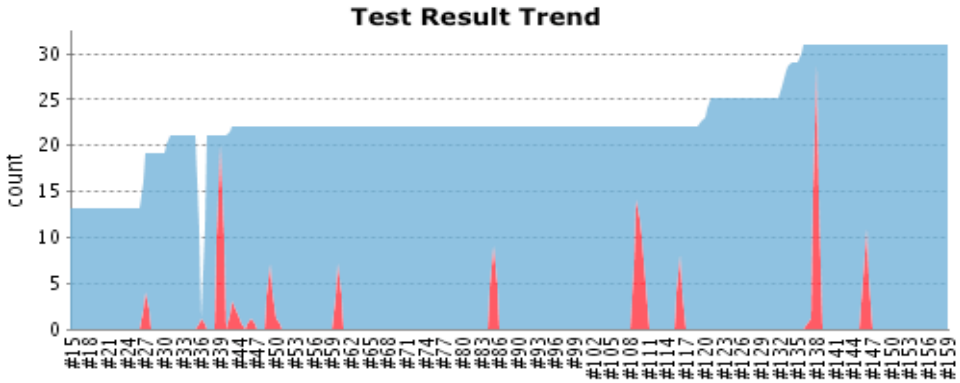
Continuous integration

- Adopted continuous integration process in July 2009
  - Using Hudson open-source tool: https://hudson.dev.java.net/
  - ASKAPsoft codebase is tested continuously and automatically
  - Each commit to the Subversion repository results in a build/test job being spawned
  - Immediate productivity improvements obvious
    - Reduced time to detect defects (particularly regressions) from days/weeks to hours
    - Easily able to identify exactly which change-set caused the problem

- Trend test additions, deletions, passes and fails over time



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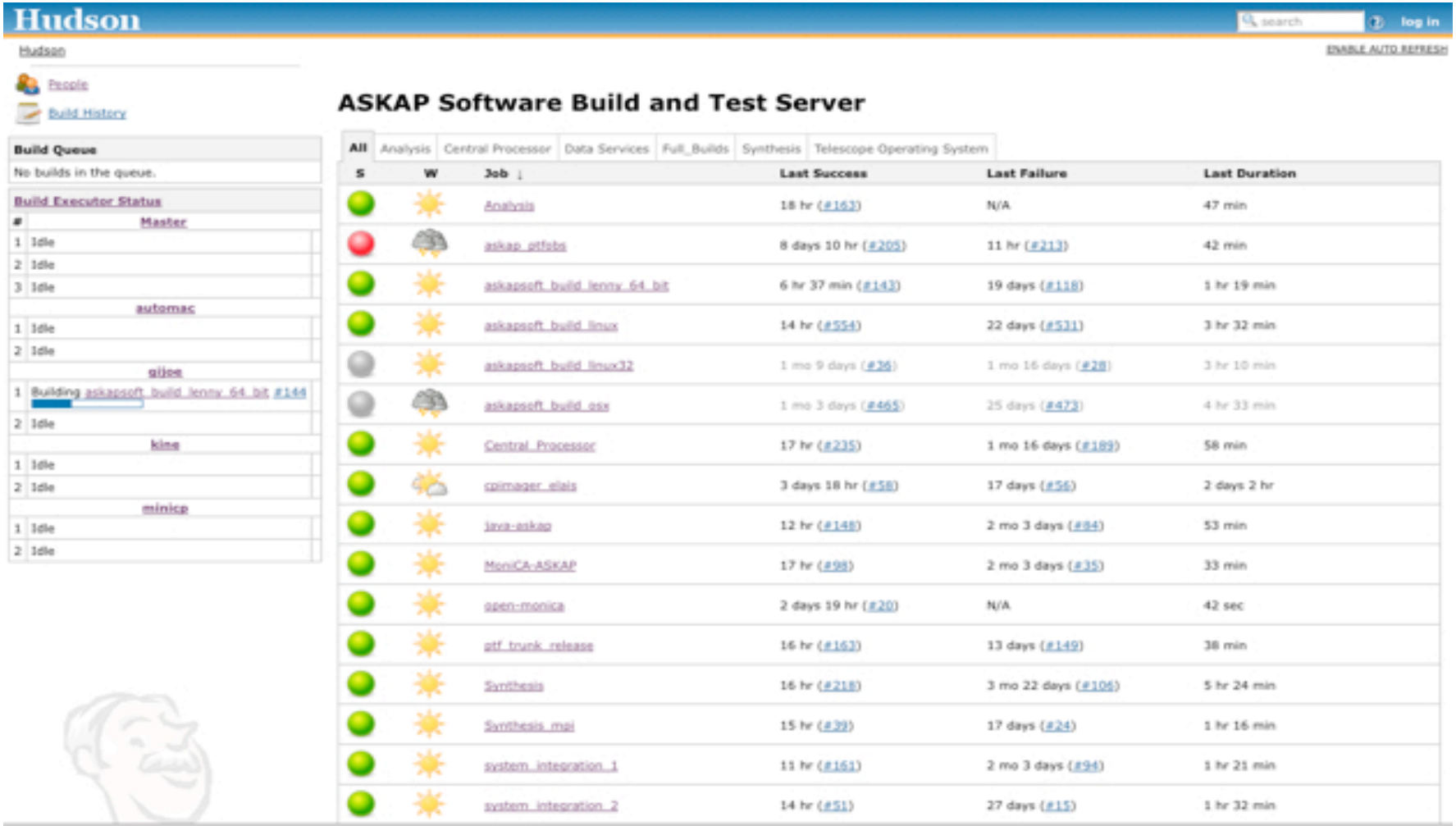
Continuous integration

- Hudson dashboard shows status of all build executors and jobs



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Square Kilometer Array (SKA)

- Download the SKA animation movie from http://www.skatelescope.org/video/SKA_Animation_2010.mov
  - Credit: Swinburne University

Square Kilometer Array
Top-level Timeline

2007 – 12	Telescope design and cost
2012	Site selection (Australia or Southern Africa)
2012 – 13	Establish SKA organisation + initial (10% SKA Phase 1) construction funding approval
2013 - 18	Detailed design & construction of Phase 1 at low and mid frequencies
End 2016	Construction funding approved for 100% SKA at mid and low frequencies
2017 - 22	Finish construction at low and mid frequencies
2019 ->	Science operations with Phase 1
2023	Full operations at low and mid frequencies
2013 - 22	High frequency technology development
2023 ->	Start construction of SKA at high

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Thank you

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